Reference System Status September 2003

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Main changes since June 2003

The current official release is version 6.2; there has not been a β–release at the time of writing (early October). Since the previous HAC, the following changes have been implemented:

- Version 6.1.1 (β–release 2 June 2003) introduced revisions to the convection and turbulence schemes, a modified Raymond filter for orography, revisions to the soil scheme and a modified algorithm for the generation of climate files with global coverage and usable for resolutions down to 0.25°. It also corrected a nasty error in the climate generation system, which has its origin in version 5.2.2.
  The modification in the convection scheme (STRACO) improves the model produced precipitation in general, in particular for convective situations. It is also intended to improve the vertical distribution of heating and moistening.
  The modifications in the turbulence scheme (CBR) increase mixing of momentum in vertically stable situations and thus maintain higher TKE values in stable conditions.
  A new explicit treatment of the effect of soil moisture freezing and thawing in the soil scheme (ISBA) has been implemented. Its effect is described by Parodi *et al.* (NL 43).
- In version 6.1.2 (23 June 2003) the 6.1.1 revisions to the CBR scheme have been withdrawn: the degradation of 10 m wind forecasts forced us to, even though the revisions lead to better scores for almost all other forecast parameters. The MC2 treatment of the lateral boundary zone has been implemented: it avoids 'water bombs' over high terrain at the boundaries, and thus avoids model failure from those. There are several improvements to the data assimilation scheme, of which the use of the first-guess at the appropriate time (FGAT) and the introduction of seasonal variation of scaling factors in the 3D-VAR scheme have the largest meteorological impact.
- After extensive validation, version 6.1.2 was accepted as an official release: Version 6.2 (8 September 2003).
- Several coding errors were corrected. None of them had a significant meteorological impact.

Detailed description of the changes

Version 6.1.1 (2 June 2003)

- *Revisions to* STRACO.
  Bent Hansen Sass wrote: Modification of the previous scheme (1999) has the primary purpose of improving the model produced precipitation in general, in particular for convective situations. It is also intended to improve the vertical distribution of heating and moistening.

- *Revisions to* CBR.
  Colin Jones wrote: The turbulence modifications increase mixing of momentum in vertically stable situations and thus maintain higher TKE values in stable conditions. This results in an improved overall dynamical structure of the model atmosphere. The RMS errors of MSLP, and geopotential height are reduced, biases in MSLP and free tropospheric wind speeds are also generally reduced. There is a slightly increased positive (hence worse - GC) bias in 10m-wind speed as a consequence of increased (downward) momentum mixing.
- *Revised subgrid-scale orography*.
  Kai Sattler wrote: The new algorithm for determination of sub-grid orographic roughness z0_oro includes a dependency on the grid spacing. This means that z0_oro over mountainous areas will decrease when the grid resolution is increased. The impact on the meteorological results is expected to be minor on 20-25 km grids. On grids with higher resolution, the meteorological impact is expected to be modest. However, 10m-wind is affected over mountainous regions.
- Raymond filter for orography.
  The orography is passed through a Raymond filter before it is used by the rest of the climate generation system and the HIRLAM forecasting system. After the Raymond filter, the grid points where the orography changed sign (including 0) due to the filter, the orography is reset to its original value, to avoid non-zero orography over sea and to preserve the shape of the Dead Sea (and some other areas below sea level).
  Colin Jones wrote: The primary impact is disappearance of 2-deltax forcing of waves from the surface over orography. These are treated wholly incorrectly in semi-Lagrangian advection. If they are present one sees large (numerical) bulls-eyes in precipitation over mountain regions, this is clearly improved with smoothed orography.
- Revised saturation pressure.
  Carl Fortelius wrote: The modification acts to reduce the saturation deficit driving the surface latent heat flux at temperatures below the freezing point, and removes a spurious equilibrium between a water cloud and the snow cover. The expected impact is a reduction of the winter-time surface latent heat flux and boundary layer relative humidity and cloudiness.
- *Several code improvements, bug corrections, etc.*

Version 6.1.2 (23 June 2003)

Withdraw the 6.1.1 revisions to CBR

The 10 m wind verification score of the SMHI operational system, that has been using the 6.1.1 CBR modifications for some time, has a bias so much larger than that of other operational systems that it has been decided to withdraw those revisions, and await further tuning of the scheme and possibly other parameters like z_0 and Charnock relation.

The MC2 lateral boundary relaxation scheme

In the MC2 scheme, the physical tendencies are relaxed towards zero in the boundary zone. Simo Järvenoja implemented and tested it for HIRLAM. A validation over two weeks in June 1997 showed similar improvements as those reported by him in

Newsletter 43. This summer period, with active convection, perhaps only highlights the unrealistic behaviour of convection at the eastern boundary when using Reference boundary treatment.
Laura Rontu added an option to interpolate TKE and cloud condensate vertically from the host model for lateral boundaries. This will have some consequence for nested models. The option is not active in the reference configuration.

Use the first-guess at the appropriate time
Ole Vignes provided the scripts to switch FGAT on. Essentially, they ensure that the forecast writes hourly history files in an interval that is centred on the next analysis time, and has a width of the cycle interval.
Note that for FGAT to work properly the minimum forecast length should be one and a half times the cycle interval.

Several changes to the HIRVDA system
Kristian Mogensen implemented a number of scientific changes. The following impact the reference configuration (3D-VAR):

- The seasonal scaling factor code now uses a pressure level input file
- European wind profiler code has been updated
- MODIS wind code included
- Improved reproducibility with different number of processors (work in progress)
- Bug in vertical interpolation for ATOVS fixed. The effect of the bug is rare since it only occurs when abs(pressure(nlev)-pressure(rttovlev))<1.e-5
- Problems with 60 levels fixed
- FGAT for PILOTs set to false as default. An outstanding problem is wind profilers which should not be treated as PILOTs with respect to FGAT (planned to be corrected in the next β–release, 6.2.1)

Kristian moved the revision control system for HIRVDA from RCS to CVS.
The HIRLAM revision control system does not work for the HIRVDA subset. A change in the HIRVDA system usually means that the user who wants to continue to use an older HIRLAM release for experimentation, will have to install a private version of the HIRVDA system valid for the older HIRLAM release, and create a private file Env_system that sets HIRVDA_ROOT to point to the private installation.
ECMWF kindly increased the permanent file space of the system manager. It allows keeping two versions of HIRVDA on-line. So besides version 6.1.2 the earlier version (6.0.0) will be kept for some time. Experiments that now use HIRVDA 6.0.0 will therefore be able to continue to do so, until the file space is needed to install a next release.

Convergence from mini- to full SMS
Mini-SMS swapped the variables SMSHOST and SMSNODE as compared to ECMWF's SMS. To facilitate the port of the HIRLAM system to an installation under full SMS, this error has been corrected, in preparation of the installation of the regular cycle with the reference system (RCR) for operations at FMI.

Asynchronous IO at ECMWF
By default now one processor of the IBM at ECMWF is allocated for IO. The total number of processors used on IBM for the forecast model is 16; of those 3 (nprocx) times 5 (nprocy) are used for calculations, and 1 for IO.

Bugs and bookkeeping
Xiaohu Yang made several changes, with effects mainly in non-reference configurations for digital filtering initialization (incremental DFI, launching etc.). Laura Rontu added code to accumulate and postprocess three-dimensional physical tendencies of wind components.

Version 6.2.0 (8 September 2003)

This version is equal to the previous β–release (6.1.2), apart from a number of code corrections (*e.g.* to initialize some variables before their usage; and to allow that the list of products disseminated from ECMWF does not include the top level(s) of the ECMWF model, as is the case in many national implementations).

Plan for the Reference system.

The snow scheme is so urgent for the RCR / FMI that the next Reference will only have this component.

- Snow scheme (fraction) in surface scheme
- Wind Profiler module in HIRVDA
- Multi-incremental code (passive) in HIRVDA
- Testing for a Reference system release (October). (6.3)

- Semi-Lagrangian T equation and extrapolation.
- CBR stable mixing extension and z0 tuning.
- Further integration of HIRVDA (revision control)
- Kain-Fritsch convection as an option.
- IDFI (Incremental DFI) as default
- Radiation interface and changes.
- Semi-Lagrangian physics coupling.
- MPI optimisation from DMI (JB).
- Testing for a Reference system release (January). (6.4)

- ATOVS active (bias correction code and files)
- Quikscat active
- Index field for background and qc in 3D-VAR. Tests to be completed and documented.
- Surface analysis upgrades, structure functions, snow analysis
- Surface parameterisation upgrades, sub-gr. run-off, constants
- Moist CBR

- New climate data bases and other updates (?)
- Kain-Fritsch as a default (?)
- Testing for a Reference system release (~May). (6.5)

- SSO and physiography.
- Radar VAD winds (?).